PATHOGENICITY OF ANTHRAX SPORES IN WHITE MICE

TRANSLATION NO.
540

JULY 1962

U.S. ARMY BIOLOGICAL LABORATORIES
FORT DETRICK, FREDERICK, MARYLAND

CCBL: FD2-3742 (T-6-2)
JPRS: R-2617-D

9 July 1962

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U. S. JOINT PUBLICATIONS RESEARCH SERVICE
BUILDING T-30
OHIO DRIVE & INDEPENDENCE AVENUE, S. W.
WASHINGTON 25, D. C.

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/Following is a translation of a French-language scientific paper by H. Velu and B. Bellocq in Comptes Rendus de la Société de Biologie (Reports of the French Biological Society), Vol. 134, Paris, 1941, pp. 1352-53./

In spite of the considerable amount of research on the mechanism of anthrax infection subsequent to the work of Besredka, the pathogenesis of pulmonary anthrax (woolsorter's disease) has not yet been completely explained. This is due in part to the fact that researchers generally have not utilized the spore, the normal agent of infection, and partly to the fact that they did not use the natural modes of entry of the bacillus which are ingestion and inhalation. They have employed the bacillus in its vegetative and much more virulent form as shown by Basset (1), and moreover, employed artificial means such as the syringe to let the pathogenic products reach the lungs without affecting the integument or else had recourse to nasal instillation (Sanarelli; Boquet and Saenz). In other words, they operated with conditions which are far removed from the normal infectious processes and it is hardly necessary to stress their artificial character. In order to investigate the problem, we have experimented with the receptivity of mice to anthrax spores introduced through the natural passages.

Contamination of the lung can be effected either by the respiratory or the digestive passages. A. Boquet and A. Saenz (2) did show that infection in the guinea pig by spores of the second anthrax vaccine is followed very quickly by bacteriemia. On the basis of the work of Dinet on perfusion, it is therefore reasonable to assume that this brings about rapid contamination of the lung which some authors explain by direct progress starting from the mouth.

In order to determine the pathogenicity of the spore we employed white mice as did A. Boquet and A. Saenz (3), however paradoxical this may seem, in spite of their high receptivity to anthrax. Instead of employing as did these authors, the second anthrax vaccine, we utilized a very virulent suspension of anthrax which killed mice at a subcutaneous dosage of 15 spores and rabbits at a dosage of 150 spores.

Ten mice resisted daily ingestion of 500 million spores in their drinking water for 2 days. This made it unnecessary to continue further.

We subsequently multiplied attempts at contamination through the respiratory passages by more than 50 tests on 350 mice, according to a procedure identical to that of Buchner and erroneously neglected by researchers. Immediately after inhalation of the infectious aerosol, 2 out of the 7 mice of each group were killed with or without anaesthesia.

The complete lungs were macerated with sterile sand, while dry, and then transferred into 5 to 10 ccm of physiological serum which was employed to infect 5 Petri dishes with 1 ccm per dish. This made it possible to count the number of spores deposited in the lung or at least to obtain basic figures. By changing the concentration of the suspension employed, we succeeded in varying this number from 1 or 2 up to 1,000. We observed that the inhalation of several hundred spores — up to 600 in mice of 25 to 30 g — never triggered the anthrax infection. Between 600 and 1,000 spores, a few mice died of septicemic anthrax, in the absence of any lesion of the integument, within 10 to 15 days subsequent to infection but these were mice in a state of weakened resistance. Already noted by A. Boquet and A. Saenz, the long period of incubation as well as the absence of the disease in mice having received less than 600 spores, confirms in all points the statements of Basset on the potential pathogenicity of the spore which requires the influence of a contributory cause for inducing germination in order to become active. This was obtained by researchers through a variety of means which are never encountered under natural conditions. We therefore need to determine the circumstances favoring germination under customary conditions. Since the low mortality subsequent to inhalation of more than 600 spores may hinder correct interpretation of results, it will be preferable not to exceed a rate of 500 spores or even stay well below this (close to the minimum fatal dose under subcutaneous administration) which was 15 spores of the strain employed in these experiments.

References

1 - J. Baset, C.R. de la Soc. de biol., 1925, Vol. 92, p. 1515.

2 - A. Boquet and A. Saenz. Ann. de l'Inst. Pasteur, 1933, Vol. 50, p. 311.

3 - A. Boquet and A. Saenz. C. R. de la Soc. de biol., 1924, Vol. 90, p. 911.

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